

3. Almost sessile apertures, transversely flattened languets *E. diaphanis*
 — Short cylindrical siphons, laterally flattened languets with a membrane between them *E. venui*
4. Only 3-5 transverse muscles between siphons .. *E. kounaci*
 — More than 3-5 transverse muscles between siphons 5
5. Meshwork of muscles on the right side of the body
 *E. imperfecta*
 — No meshwork of muscles on the right side of the body 6
6. 11 rows of stigmata *E. diligens*
 — More than 11 rows of stigmata 7
7. Anterior border of gut loop level with the anus *E. krishnani*
 — Anterior border of gut loop not level with the anus 8
8. Stomach with longitudinal folds *E. bombayensis* — Stomach without longitudinal folds 9
9. With conspicuous siphons *E. styeloids*
 — Without conspicuous siphons 10
10. Large carpet-like colonies with prostrate zooids, cloudy body wall, large spherical smooth stomach *E. nexa*
 — Colonies not crowded, erect zooids, body wall not cloudy, small oval smooth stomach *E. garstangi*

ACKNOWLEDGEMENTS

The author expresses her deep sense of gratitude to Dr. T.K. Renganathan, former Professor, Department of Zoology, V.O. Chidambaram College, Tuticorin, for his kind help in the identification of specimens and to the U.G.C., New Delhi, for financial assistance.

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12. BIODIVERSITY OF WILD SILK MOTHS IN NAGALAND

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Introduction

Wild silk moths are a relatively well-known group of insect fauna of Family Saturniidae. They are admired by

people throughout the world (Peigler 1996). A good number of references are available on seribiobiodiversity and its potential as the source of natural silk in the Indian subcontinent,

extending from the sub Himalayan to Sri Lankan region (Arora and Gupta 1979; Thangavelu 1991; Nassig *et al.* 1996; Chinnaswamy 2001; Thangavelu *et al.* 2002; Srivastava and Thangavelu 2005). North-eastern India is the centre of wild silk culture and several kinds, including muga, eri, tropical tasar, temperate tasar and fagara silks are produced here (Peigler and Naumann 2003). However, biodiversity of silk moths in the wild of North-eastern India is not yet fully understood as their distribution is restricted to highly inaccessible areas. While some stray reports on the exploration of wild sericigenous or silk producing insects from north-eastern region are available (Thangavelu and Borah 1986; Thangavelu *et al.* 1987; Bhattacharya *et al.* 2004), information on the biodiversity and distribution of wild silk moths in Nagaland is not available.

Nagaland, one of the north-eastern states of India, is situated in the trans-Himalayan region between 25° 26'-27° 40' N and 93° 20'-95° 15' E. The topography of Nagaland is characterised by hills and mountains, and deep gorges and steep slopes. The altitude of the area varies from 199 m to 3,841 m. Nagaland state, like Manipur, is the meeting place of the Siberian and Manchuria sub-regions of the Palaearctic Region, and the Indo-Chinese and Indian sub-regions of the Oriental Region. Nagaland has rich forest resources with forests covering over 85.43% of the total land surface. Humid mesothermal warm temperate with dry winter Gangetic type climate prevails in the state. The average annual rainfall is 2,584.5 mm having wet season from May to October. The temperature ranges from 12 °C to 32 °C in summer and 5 °C to 20 °C in winter, and the average relative humidity varies from 67% (March) to 88% (October).

Table 1: Wild silk moths of Family Saturniidae in Nagaland

Common name	Scientific Name
Muga silk moth	<i>Antheraea assamensis</i> (Helfer)
Oak tasar silk moth	<i>Antheraea roylei</i> (Moore)
Oak tasar silk moth	<i>Antheraea proylei</i> (Jolly)
Oak tasar silk moth	<i>Antheraea frithii</i> (Moore)
Indian moon moth	<i>Actias selene</i> (Hubner)
—	<i>Actias rhodopneuma</i> (Rober)
Atlas moth	<i>Attacus atlas</i> (Linnaeus)
—	<i>Archaeoattacus edwardsii</i> (White)
—	<i>Cricula trifenestrata</i> (Helfer)
Wild eri moth	<i>Samia canningi</i> (Hutton)
Indian eri moth	<i>Samia ricini</i> (Donovan)
—	<i>Sonthonnaxia maenas</i> (Doubleday)
—	<i>Loepa katinka</i> (Westwood)
—	<i>Loepa sikkima</i> (Moore)

A recent review of the species composition of India listed 47 species of wild silk moths (Singh and Suryanarayana 2005) of which 24 species (Singh and Chakravorty 2006) of Family Saturniidae are found in north-east India. Of these only three species, namely *Antheraea assamensis*, *Antheraea roylei* and *Attacus atlas* have been reported from Nagaland. Hence, an attempt has been made to study wild silk moths, highlighting their bio-ecological characteristics, ecological traits and host plants distribution, in Nagaland.

Material and Methods

An extensive survey was carried out in Nagaland during 2004-2005 to collect wild silk moths and record their host plants. Identification of the collected material was made using literature. All the material reported here is in the collection of the Ecology Laboratory, Department of Zoology, Nagaland University, Mokochung. Description of adult morphological characteristics was limited to those silk moth species for which host plants were not ascertained. However, other species, i.e., *Antheraea assamensis* (commercially reared and wild variety), *A. roylei*, *A. proylei*, *Actias selene*, *C. trifenestrata*, *Samia canningi* and *S. ricini*, were reared on their most suitable host plants at the Ungma sericulture farm, Govt. of Nagaland, to study various parameters like colour, size and weight of different life stages and economic traits.

Results and Discussion

Table 1 presents a list of 14 species belonging to 8 genera collected during the survey. Among these only adults of *Antheraea frithii*, *Attacus atlas*, *Archaeoattacus edwardsii*, *Sonthonnaxia maenas*, *Loepa sikkima* and *L. katinka* were collected without confirmation of their host plants. Both the adult as well as larval stages of the rest of the species, i.e., *Antheraea assamensis*, *A. roylei*, *A. proylei*, *Actias selene*, *C. trifenestrata*, *Samia canningi* and *S. ricini*, with their primary and secondary host plants distributed in different parts of Nagaland, were recorded. The wild variety of *A. assamensis* which is large in size and deeper in colour was also recorded from same areas of Nagaland. It is trivoltine undergoing partial diapause in the pupal stage during winter. Further, worms of wild variety are very much active and strong, and cocoon characters such as colour, weight and size are different from the cultivated population. The tubercles are brick red. Lower lateral tubercles are prominent and green. The lateral line is very prominent and yellowish with a green shade. The white shining spots extend around the base of dorsal tubercles from second thoracic to eight abdominal segments. All the species are polyphagous.

MISCELLANEOUS NOTES

Table 2: List of host plants of wild silk moths in Nagaland

Silkworm species	Name of host plants	Vernacular names of host plants	Distribution of host plants
1. (a) <i>Antheraea assamensis</i> (commercially reared)	<i>Persea gamblei</i> (= <i>P. bombycina</i>)	Som	Mokokchung, Wokha, Tuensang, Dimapur
(b) <i>Antheraea assamensis</i> (wild)	<i>Litsea monopetala</i> (= <i>L. polyantha</i>) <i>Litsea salicifolia</i> <i>Litsea cubeba</i> (= <i>L. citrata</i>)	Soalu Dighloti Mejankari	
2. <i>Antheraea proylei</i>	<i>Quercus acutissima</i> <i>Quercus griffithii</i> <i>Quercus semeserrata</i> <i>Quercus incana</i>	Oak trees	Kohima, Phek, Kiphire, Tuensang, Mokokchung
3. <i>Antheraea roylei</i>	<i>Terminalia myriocarpa</i> <i>Betula alnoides</i>	Hollock Meriamtong	Throughout Nagaland
4. <i>Attacus atlas</i>	<i>Maesa indica</i>		Mokokchung, Wokha, Phek, Zunheboto
5. <i>Actias selene</i>	<i>Rhus javanica</i> <i>Alnus nepalensis</i> <i>Betula alnoides</i> <i>Prunus cerasoides</i> <i>Evodia fraxinifolia</i> <i>Persea gamblei</i>	Tangmo Alder Meriamtong Cherry Payam Som	Throughout Nagaland
6. <i>Cricula trifenestrata</i>	<i>Persea gamblei</i> <i>Litsea cubeba</i> <i>Betula alnoides</i>	Som Mejankari Meriamtong	Mokokchung, Tuensang, Wokha, Dimapur
7. <i>Samia ricini</i>	<i>Ricinus communis</i> <i>Heteropanax fragrans</i> <i>Evodia fraxinifolia</i> <i>Manihot esculanta</i>	Castor Kesseru Payam Cassava / Tapioca	Throughout Nagaland
8. <i>Samia canningi</i>	<i>Ricinus communis</i> <i>Heteropanax fragrans</i> <i>Evodia fraxinifolia</i> <i>Manihot esculanta</i> <i>Duanbanga sonneritoides</i> <i>Anthocephalus cadamba</i> <i>Litsea salicifolia</i> <i>Litsea cubeba</i> <i>Psidium guajava</i> <i>Zanthoxylum armatum</i>	Castor Kesseru Payam Cassava / Tapioca Khokon Kadam Dighloti Mejankari Guava Mejanga	Throughout Nagaland

feeding on more than one plant. Except for a few host plants, which are site specific, others are found throughout Nagaland (Table 2).

The eight wild silk moth species were reared on their most suitable host plants to analyse the morphological characteristics. They exhibit biodiversity in all aspects of their

lives from egg to adult stages and in their food habits, consumption and morphological traits among themselves (Table 3 a,b). The species were seen distributed in different parts of the state. Except for *Antheraea roylei*, which produce double layered cocoon, all other silkworms produce cocoons with a single layer. *Cricula trifenestrata* is conspicuous in

Table 3a: Morphological characteristics of certain wild silk moths in Nagaland

Characteristics	<i>A. assamensis</i> (W)	<i>A. assamensis</i> (C)	<i>Actias selene</i>	<i>Samia canningi</i>
EGG				
Colour	Reddish brown to blackish brown	Reddish brown to blackish brown	Grey	Brownish to creamy white
Size (mm)	2.0-2.5 x 1.8-2.0	2.5 x 2.2	2.5 x 2.3	1.6 x 1.2
Weight (gm)	0.008	0.005-0.007	0.004	0.001
LARVA Early				
Colour	Orange-yellow	Orange-yellow	Chocolate to orange brown	Yellowish black
Size (mm)	8.6-12 x 1.0-2.0	9.8-10.2 x 1.0-2.0	7.2-7.8 x 1.4-1.6	7.1-7.3 x 1.2-1.5
Weight (gm)	0.03-0.06	0.02-0.07	0.03-0.05	0.01-0.05
Mature				
Colour	Light to dark green, brick red tubercles	Light to deep green	Dark green to light green	Yellowish
Size (mm)	82-106 x 14-16	82.8-90.7 x 1.3-1.6	78.6-85.4 x 13.8-14	69-72.8 x 11.4-12.4
Weight (gm)	8.5-13.8	7.5-7.8	11.4-11.6	5.5-6.1
COCOON				
Colour	Single layered White to pinkish golden brown	Single layered Golden to light brown	Single layered Pale creamish	Single layered Grey, orange brown brick red
Size (mm)	45.4-51.2 x 13.8-16.4	42.3-50.1 x 15.4-20.8	45.8-58.8 x 21.6-25	35.6-44.6 x 11.8-16.6
Weight (gm)	5.14-8.33	4.6-6.0	6.94-8.70	1.64-2.69
Peduncle (mm)	70-137	15-52	-	77-164
Shell wt. (gm)	0.55-0.75	0.54-0.71	0.29-0.55	0.22-0.40
Shell ratio	9.87-12.65%	9.45-11.87%	5.35-7.13%	11.16-15.75%
Filament (m)	304.76-364.6	365.5-409.2	135-242	-
Denier (d)	4.9-5.0	5.1-5.7	7.85-8.93	-
PUPA				
Size (mm)	41-42 x 11.8-14.4	34.5-42.3 x 13.3-14.4	36-55.2 x 9.6-17.4	23.4-28.2 x 7.2-9.0
Weight (gm)	4.90-7.56	4.31-5.34	4.34-9.47	1.41-2.38
MOTH				
Wing expanse (cm)				
Male	14.6-14.7	10.6-13.5	12.3-14.1	11.5-12.6
Female	16.6-16.9	12.4-15.1	15.6-18.9	14.1-15.5
Colour				
Male	Chocolate to orange brown	Deep brown	Blue green to chocolate	Dark brown to pinkish white
Female	Orange to reddish brown	Light brown	Blue green to chocolate	Dark brown to pinkish white
Volturnism	Trivoltine	Multivoltine	Trivoltine	Bivoltine

W: wild variety; C: commercially reared

Table 3b: Morphological characteristics of certain wild silk moths in Nagaland

Characteristics	<i>Samia ricini</i>	<i>Antheraea roylei</i>	<i>Antheraea proylei</i>	<i>Cricula trifenestrata</i>
EGG				
Colour	Ivory white	Greyish brown to bluish green	Blackish brown to bluish green	Ivory white
Size (mm)	1.9 x 1.3	2.8 x 2.4	2.8 x 2.5	1.8 x 1.2
Weight (gm)	0.002	0.005-0.009	0.006-0.008	0.004
LARVA Early				
Colour	Yellowish black	Black	Black	Yellowish brown
Size (mm)	5.8 x 1.8	9.4 x 1.7	9.6 x 0.18	6.2-6.6 x 1.2
Weight (gm)	0.02-0.05	0.027	0.034	0.029-0.033
Mature				
Colour	Creamy	Green with bluish tubercles	Green-purple to bluish tubercles	Dark brown to pinkish bands
Size (mm)	64-70 x 10.2-10.6	96.6 x 15.8	86.4 x 13.8	56.4-60 x 7.0-8.6
Weight (gm)	8.2	12.5-23.1	13.10	2.52-2.56
COCOON				
Colour	Single layered Dark to reddish brown	Doubled layered Whitish	Single layered Reddish brown to light metallic	Perforated Golden yellow
Size (mm)	43.8-46.8 x 16.4-19.4	45.4-54 x 24.4-27.4	41.6-5.10 x 18.2-27.4	30-41.6 x 7.2-14.4
Weight (gm)	4.12-4.28	6.6-11.5	4.92-7.62	0.958-2.01
Peduncle (mm)	-	93.2-170.4	46.0-63.4	62.2-93.6
Shell wt. (gm)	0.58-0.64	0.55-0.80	0.55-0.78	0.102-0.228
Shell ratio	13.5-14.9%	6.96-8.30% **	10.18-12.35%	8.0-13.33%
Filament (m)	-	234-473	270-546	-
Denier (d)	-	4.7-5.7	4.9	-
PUPA				
Size (mm)	28.2-29.0 x 10.4-11.6	38.2-45.2 x 18.2-28.6	36.6-40.8 x 14.8-21.6	22.2-27.6 x 4.8-11.2
Weight (gm)	3.54-3.64	4.51-11.18	4.33-6.84	0.84-1.78
MOTH				
Wing expanse (cm)				
Male	10.5-13.5	13.2-15.5	12.3-15.3	5.6-7.8
Female	11.5-14.1	15.2-17.5	13.5-17.2	7.5-8.1
Colour				
Male	Brown and black with pink border	Greenish grey	Greyish brown	Orange brown
Female	Brown and black with pink border	Yellowish brown to dull brown	Greenish brown	Orange brown
Volitism	Multivolitine	Bivolitine	Bivolitine	Bivolitine

having perforated a cocoon. Shell ratio is minimum in *Actias selene* and maximum in *Samia ricini*, the domesticated eri silk cocoon. The length of a single cocoon filament was maximum in the cultivated *Antheraea assamensis* and minimum in *Actias selene*; however, denier is minimum in *Antheraea assamensis*.

ACKNOWLEDGEMENTS

Financial assistance by the G.B. Pant Institute of Himalayan Environment & Development, Almora, under the research project Biodiversity, Ecology and Conservation of wild silk moths in Nagaland is gratefully acknowledged.

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13. FIRST RECORD OF THE COLOUR SERGEANT *ATHYMA NEFTE* IN PHANSAD WILDLIFE SANCTUARY IN RAIGAD DISTRICT, MAHARASHTRA, INDIA

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The Colour Sergeant *Athyma nefte* (Cramer) is distributed in North-east Himalayas from Sikkim to Arunachal Pradesh, from Nepal and Bhutan; and from Bangladesh and Myanmar to Orissa and Andaman Islands (Evans 1932; Wynter-Blyth 1957; Kehimkar 2008).

In southern India, Mr. Rhodes-Morgan collected a single male specimen from the Wynaad district of Kerala (de Nicéville 1886). The Colour Sergeant (*Athyma nefte*) belongs to the Family Nymphalidae and is classified as rare to southern India by de Nicéville (1886).

We saw a Colour Sergeant on November 09, 2007, in Phansad Wildlife Sanctuary, which is about 45 km west to the Western Ghats crestline. It was basking on a small shrub in bright sunlight at around 0900 hours in "Chikhalgaan" area. Evans (1932), Wynter Blyth (1957) and Kehimkar (2008) stated that this butterfly prefers wet and hilly regions

of evergreen forests of the Western Ghats. The occurrence of this butterfly in Phansad, the first record of this butterfly from Maharashtra, indicates that this could be the northernmost extension of c. 340 km from the known record – a male Colour Sergeant in Goa, in August 2008 (D. Raju, pers. comm.).

The information on the distribution of this butterfly is anecdotal, especially from southern India. Intensive field survey all over the northern Western Ghats is essential to evaluate the distributional range and present status.

ACKNOWLEDGEMENTS

I thank Mr. Isaac Kehimkar, BNHS, for confirming the identification of the butterfly. I thank Dr. Girish Jathar, BNHS, for his comments on the manuscript.